Dynamic Model User Guide

Engage Consulting Limited

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Document Control

Authorities

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1 Introduction

1.1 Background

This user guide describes how to use the dynamic model, built in Excel, which simulates the Project Nexus settlements processes. The model will be used by the PAW to assess each performance risk identified within the Gas Market Settlement Risk Assessment report.

The model simulates the post Nexus settlement arrangements for an averaged sized LDZ with seven shippers operating in a competitive market. The core model is set up to replicate gas settlements without any risk to allocation or reconciliation volume for one day.

To assess each risk the model uses an error distribution to identify the 1 in 20 worst-case event and quantify the inaccuracy that it would create if it materialised. Each risk can affect products 1-4 differently. The risk in kWh per day is run through the model to determine the value at risk and how it is distributed among shippers in the LDZ. The PAW will be able to update key reference data and run different scenarios to find the most appropriate value at risk.

The model assesses the following risks:

1. Identified LDZ offtake measurement errors;
2. Undetected LDZ measurement errors;
3. Meter read validation failure;
4. Failure to obtain meter readings;
5. Estimated reads used on daily read sites;
6. Meter read submission frequency for product 4;
7. Insufficient maintenance of the supply point register;
8. Estimates used at change of shipper;
9. Late or incomplete check reads;
10. Shipperless sites;
11. Theft of Gas;
12. Fair Use of the AQ correction process;
13. Lack of WAR Band calculation for qualifying sites in product 4;
14. Fair use of retrospective updates; and
15. Unregistered sites

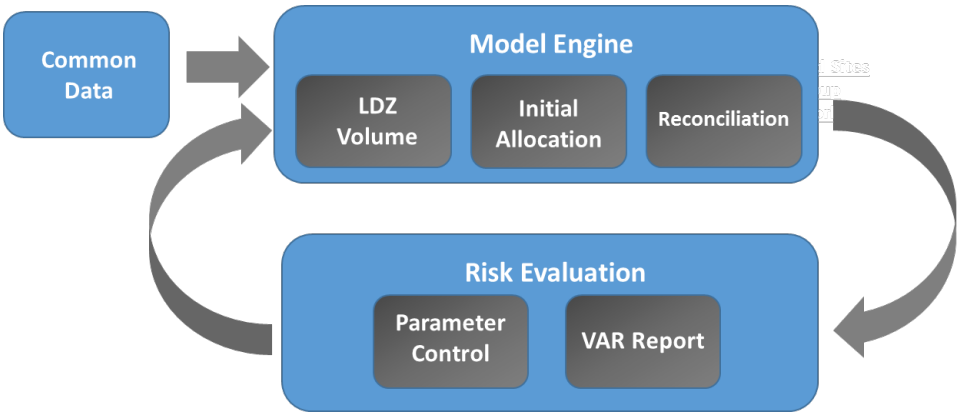
This document and the dynamic model assumes the reader has an understanding of the current and future settlement arrangements.

2 Description of the Model

2.1 Model Construction

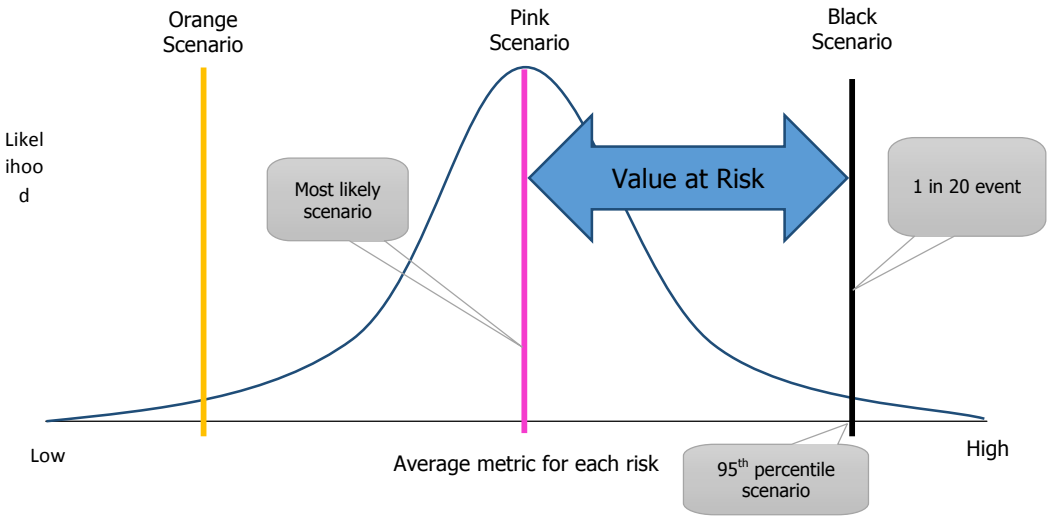
The model uses common data to convert the gas volume entering into an LDZ into identified and unidentified gas. These two categories are then split by product category to derive the initial allocation and reconciliation volume. The market shares are used to divide the energy allocation between the 7 shippers in the market. The reconciliation process simulates individual meter point reconciliation and the redistribution of energy through unidentified gas. The energy will be redistributed to Shippers' based on an approximation of consumption over the last 12 months. Market share data is used as an approximate value. The model has market share data at the start and end of a model year and uses the average of the two values; this assumes a linear change from start to end.

The basic model structure is shown below. Each of the risks vary the initial allocation or final reconciliation or both as they are fed through the model. The parameter control element of each risk determines which product category the risk impacts.



2.2 Value at Risk Report

The Value at Risk (VAR) is determined as the difference between the cost incurred between the reference scenario (where there are no risks) and the scenario where the cumulative probability is 95%. The 95% worst-case scenario uses normal or binomial distributions shown in appendix A. The relevant distribution is determined dependant on whether the data is discrete or continuous. The graph below shows the probability distribution of a normal and binomial function.



2.3 Net Effect of Settlement Risks

Where a risk has equal and opposite effects, only half of the risk is assessed. LDZ meter errors initially effect NTS shrinkage and this cost is then moved to energy allocation. The model does not assess the impact on NTS shrinkage. Similarly, where an estimated transfer read is used the impact to one shipper is evaluated.

2.4 Compatibility

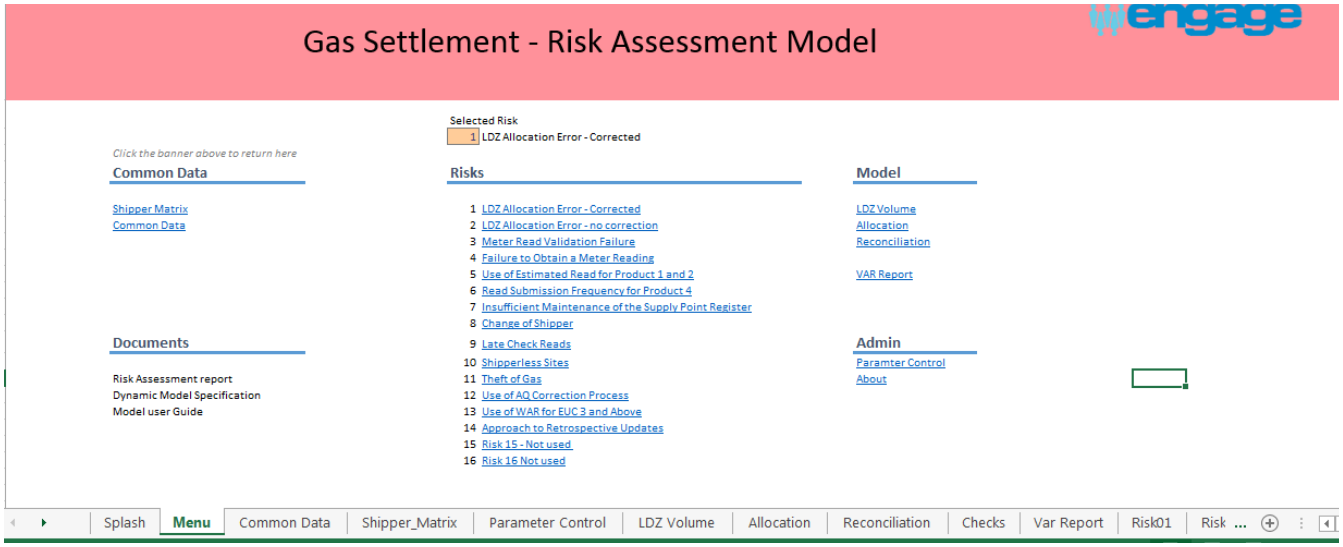
We have built the model in Microsoft Excel 2013. It does not contain SQL or macros. This model requires a minimum of Excel 2007 and earlier versions of MS Excel will not display the model correctly.

3 How to Navigate Through the Model

3.1 Menu

The menu tab is to navigate around the model.

The model only assesses one risk at a time. The user should select the risk to assess using the drop down on the menu tab. The selected risk will then be highlighted green.



3.2 Using the model

The model simulates an average LDZ for an average settlement day. The model is currently configured to default specifications determined by Engage Consulting and can be run without any configuration by the PAW if desired. The default values are shown in Section 5. The model characteristics are sensitive to the size of shippers within the simulated LDZ and their product uptake. The common data also determines the volume of gas and number of customers.

The current breakdown of the market has been determined to reflect reality with shippers having a mixed portfolio of customers. The common data has been determined to be an average LDZ using average data as published on the National Grid website.

Some parameters used for probability distributions should be updated with newer information when available; however, in cases where data from the Mod 81 and AUGE reports have been used, model users will need to find alternative data as these reports will not be published in their current format from 2016 onwards. Section 4 describes how to update each risk.

Throughout the model, input cells are formatted consistently in in light brown to indicate where the model user can make updates.

4 Using the Model to Assess Performance Risks

The model documents which data it has used to determine the 95% worst-case scenario for a risk and where the user can get current data for the model. In some instances, where no data is available, Engage has estimated the impact and probability.

When using the model to assess each risk use the menu tab to move between risks. The table embedded within each risk shows the value at risk to shippers 1-7. This VAR is driven by product uptake and shipper market share. If this table is red, then risk is not the currently selected risk – see the menu tab for how to select a risk.

£000s/Year	Allocation				Reconciliation			
VAR	£ 21,152				£ -			
Supplier	Reference	Risk	Variance	%	Reference	Risk	Variance	%
Small Polluter	£ 35,916	£ 35,339	-£ 577	-2%	£ 35,856	£ 35,856	£ -	0%
Medium Polluter	£ 43,415	£ 42,717	-£ 698	-2%	£ 43,472	£ 43,472	£ -	0%
Large Polluter	£ 158,531	£ 155,983	-£ 2,549	-2%	£ 158,432	£ 158,432	£ -	0%
Small Polluted	£ 59,860	£ 58,898	-£ 962	-2%	£ 59,801	£ 59,801	£ -	0%
Medium Polluted	£ 52,888	£ 52,037	-£ 850	-2%	£ 52,831	£ 52,831	£ -	0%
Large Polluted	£ 185,238	£ 182,260	-£ 2,978	-2%	£ 185,359	£ 185,359	£ -	0%
Residual Polluted	£ 779,764	£ 767,228	-£ 12,537	-2%	£ 779,863	£ 779,863	£ -	0%

4.1 R1. Identified LDZ Offtake Measurement Errors

The model assesses the risk offtake measurement errors create to accurate allocation. The settlement process initially allocates the error to NTS shrinkage. With the correct LDZ throughput, volume adjustments will fall into unidentified gas reconciliation and it will allocate energy to shippers according to their consumption share over the previous 12 months. This error affects all products 1-4 according to their consumption.

4.1.1 Data Used

Data from the Measurements Errors Registered, which is kept on the Joint Office website is used to evaluate the probability and impact of an offtake error occurring on an LDZ. The register can be found here: http://www.gasgovernance.co.uk/MER. It is updated periodically when measurement errors are identified. We have used the following data:

- Number of meter errors: 127 errors;
- Total number of offtake meters: 187 offtake meters;
- Period: 8 years;
- Average error which has been reported: 96,781 kWh per day;
- Average length per error: 297 days; and
- Total length period: 3650 days.

4.1.2 Determining the 95% Worst-case Scenario

In each case we are assessing the probability of the number of offtake meter errors occurring in our average LDZ on any given day. This can be approximated by a binomial probability distribution. The parameters are as follows;

- n is the average number of offtake meters in an LDZ. This has been determined to be number of meters/number of LDZs; and

- p is the probability of 1 meter having an error on any given day. This is determined as number of meter errors/ number of meters X average length per error/ total period measured.

Using this distribution X-Binomial (14.38, 0.0641), where the number of meters is 14.38 and the probability of each one having an error is 6.41%. The 95% worst-case scenario has been determined as 3 errors within the same LDZ on the same day.

4.1.3 Updating the Data

When the Measurement Error Register has new data, the model's user can use this to determine new inputs for this risk. The inputs derived from the Measurement Error Register are; the probability of an LDZ measurement error occurring on a given day, the average length of an LDZ meter error, the overall time that the sample covers and the total number of errors over the sample period.

Number of LDZ Off take Errors	127	*Measurement Error reports total*
Total Number Offtake Meters	187	*All the offtake meters on the system*
Average Days per Error	297	*Information comes from measurement error register to be over written by the PAW*
Total Metering errors	3650	*(GWh) Information comes from measurement error register to be over written by the PAW*
Average Error per fault day	96,781	*kWh*
Latest end date- earliest start date	3260	*Information comes from measurement error register to be over written by the PAW*
Probability of an error occuring per day	0.0619	*Probability of a meter having a fault on any day*
Number of offtake meters per LDZ	14.38	*Average LDZ meters*
1 in 20 worst case no of faults	3.00	*Using a binomial distribution with n =no of Offtake meters and p=probability of an error occuring per day*
Energy error for VAR	290,342	*Daily kWh error*

The model's user should update Risk 01 data with a refreshed version of the Measurement Errors Register following the identification and evaluation of an offtake meter error. Records with errors that do not have a start and end date must be removed.

4.2 R2. LDZ Offtake Measurement Errors that remain undetected

Where an offtake measurement error is not detected then the error will never be corrected. Where an error occurs and remains undetected, the proportion of NTS Shrinkage will remain inaccurate. The model assess the risk to initial allocation and final reconciliation following the end of the settlement window. This risk affects all products 1-4.

4.2.1 Data Used

Risk 2 should also be updated with information from the Measurement Errors Register. We have used the same data as risk 1 and added the probability of an error remaining undetected.

4.2.2 Determining the 95% Worst-case Scenario

In each case, we are assessing the probability of the number of offtake meter errors occurring on our average LDZ on any given day and not being detected. This can be approximated by a Binomial probability distribution X – Binomial (n, p). Where n = 14.38 (number of meters on an average LDZ) and

p = (number of meter errors/ number of meters) X (average length per error/ total period measured) X probability of remaining undetected. We have determined the detection probability as 10%. If the probability of detection falls below 5% this risk diminishes.

4.2.3 Updating the Data

The PAW should update the probability of a meter error occurring and the probability of it remaining undetected.

4.3 R3. Meter Reading Validation Failure

The model assesses the risk caused by meter read validation failure. Validation failure will occur when a comparison of the reading (and advance) against an expected value falls outside either of the two tolerance levels derived from the current AQ and/or SOQ.

When meter read validation failure occurs individual meter point reconciliation is suppressed, and the historical AQ remains live. It is likely that as consumption trends are falling this AQ will be on average, higher than actual consumption. The responsible shipper will pay for more gas than the supply point consumes and this will adjust unidentified gas accordingly. A risk to other shippers is created when the shipper pays for less gas than their customers consume.

The principle risk because of meter read failure are inaccurate AQs and delayed reconciliations. There is a corresponding impact of late reconciliation on the unidentified gas reconciliation energy. This risk affects product 4 only.

4.3.1 Data Used

The Mod 81 report 10 provides the following data;

- Average AQ;
- Percentage change in AQ between 2013 and 2014;and
- Standard deviation of the percentage change.

Xoserve's data of latest meter reading date, for all MPRNs in the East Midlands has been used to the number of MPRNs within the model that have not had a meter read accepted by Xoserve within the last 12 months.

Average AQ	18698	*Mod 81 Report- EUC 01-08*
Average AQ change between 13-14	-2.16%	*Mod 81 Report- EUC 01-08*
Standard Deviation	2.97%	*Spread of Change in AQ values between Shippers*
Average Decrease in AQ	- 538	
Standard Deviation	556	
1 in 20 Scenario - Change in consumption	377	*Derived using a normal distribution*
Percentage of MPRN not read in a year	5.53%	*Data provided using Xoserve's sample data*
Energy error for VAR	125,476	*Daily kWh error*

4.3.2 Determining the 95% Worst-case Scenario

The model uses a normal distribution and average AQ change to determine the 95th percentile scenario. We have derived the average AQ change using the Mod 81 report.

4.3.3 Updating the Data

Users of the model will need to find an alternative source for the average AQ and the rate of AQ change following Nexus go-live when the currents reports are no longer available.

4.4 R4. Failure to Obtain a Meter Reading

The model assesses the risk of shippers failing to obtain meter reads within the settlement window of 36-48 months. For ease of assessment, we have determined the settlement window to be 42 months (the average of 36 and 48). Where reads are not obtained, the current AQ will be out of date and the MPRN will have incomplete reconciliation. This risk affects product 4 only.

4.4.1 Data Used

Where the current AQ is historical, the true consumption is more likely to differ from the AQ. To assess the risk we have used data from Xoserve to determine the percentage of sites that do not have a read accepted on the UK Link system within the last 42 months. We have used the last 4 years' Mod 81 reports to determine average yearly reduction in AQ.

Sample of latest meter read > 42 months	4,811	*Sample provided by Xoserve of East Midlands*
Total	2,191,244	*Samples provided by Xoserve of East Midlands*
Percentage of MPRNs with latest read outside the settlement window	0.22%	*Samples provided by Xoserve of East Midlands*
Average AQ 2011	20,451	*Mod 81 Report 10*
1 in 20 consumption change in 2011	678	*Normal Distribution*
Average AQ 2012	19,458	*Mod 81 Report 10*
1 in 20 consumption change in 2012	143.65	*Normal Distribution*
Average AQ 2013	19,469	*Mod 81 Report 10*
1 in 20 consumption change in 2013	824.05	*Normal Distribution*
Average AQ 2014	18,698	*Mod 81 Report 10*
1 in 20 consumption change in 2014	510.56	*Normal Distribution*
Total change over 42 months	1,817.41	*kWh error per MPRN*

4.4.2 Determining the 95% Worst-case Scenario

We have applied a normal distribution to the last 4 years Mod 81 data to determine the compound 95% worst-case difference between the AQ and the true consumption of the MPRNs that have not had a meter reads accepted by Xoserve. In each case, the worst case is determined to be where the AQ is understated.

4.4.3 Updating the Data

The model's user will need to find a new source of average AQ and the rate of AQ change following Nexus go-live. It may be possible to request from Xoserve an ad-hoc report showing the latest meter read acceptance date.

4.5 R5. Estimated Reads used for daily read sites

The model assesses the risk of estimated reads being used to settle daily read sites. Daily read estimates for product 1 and 2 are generated to repeat the consumption from a week ago (7 days previously) and where there is no consumption history an estimate of AQ/365 will be used. The use of estimated reads will only materially affect settlement if there is no replacement read within gas flow day+5. MPRNs with significant usage can have volatile consumption. Only when a check read is completed will the correct consumption for a site be determined. The model assesses the impact of estimated reads being used for daily-metered sites at initial allocation and evaluates where check reads are not completed.

4.5.1 Data Used

The number of daily read estimates is derived using the total number of daily read sites and applying the percentage read failure falling outside both tolerance levels. Xoserve published this for the Project Nexus meeting on 24th November 2014. The risks is split into product 1 and

product 2, which can be updated separately as transporters are responsible for check reads on sites in product 1 and shippers are responsible for updating sites in product 2.

Data from the Mod 81 report has been used to determine the average AQ for EUC 07-09.

Total number of reads for product 1	1,100	*From shipper matrix tab*
Total number of reads for product 2	2,200	*From shipper matrix tab*
Percentage read failure for product 1	1.6%	*Percentage that fail outer tolerance from Xoserve's data provided to the Nexus Workgroup on 24th November 2014- **To be updated by the PAW with more accurate information.***
Percentage read failure for product 2	1.6%	*Percentage that fail outer tolerance from Xoserve's data provided to the Nexus Workgroup on 24th November 2014- **To be updated by the PAW with more accurate information.***
Number of estimated reads for product 1	18	*Estimates per day (Reads by failure rate)*
Number of estimated reads for product 2	35	*Estimates per day*
Average yearly AQ change by MPRN for Product 1	840,154	*2014 Mod 81 Report 10 - EUC 07, 08 and 09, from Risk 05 data sheet*
Standard Deviation	8,227,834	*2014 Mod 81 Report 10 - EUC 07, 08 and 09, from Risk 05 data sheet*
Average yearly AQ change by MPRN for Product 2	840,154	*2014 Mod 81 Report 10 - EUC 07, 08 and 09, from Risk 05 data sheet*
Standard Deviation in AQ change for Product 2	8,227,834	*2014 Mod 81 Report 10 - EUC 07, 08 and 09, from Risk 05 data sheet*
Average energy between estimate and actual product 1	2,302	*kWh per day*
1 in 20 Scenario annual estimated difference for product 1	39,380	*Daily difference in kWh using a normal distribution*
Average energy between estimate and actual Product 2	2,302	*kWh per day*
1 in 20 Scenario annual estimated difference Product 2	39,380	*Daily difference in kWh using a normal distribution*
Percentage of check reads completed by transporters	99.8%	*Product 1 only*
Percentage of check reads completed by shippers	99.8%	*Product 2 only*
Initial Energy error for P1	693,089.77	*Daily kWh error*
Initial Energy error for P2	1,386,180	*Daily kWh error*
Final Energy error for P1	1,386.18	*Daily kWh error*
Final Energy error for P2	2,772	*Daily kWh error*

Over time, the average AQ may reduce as smaller MPRNs are elected into product 2.

4.5.2 Determining the 95% Worst-case Scenario

A normal distribution has been used to determine the 95% worst-case scenario with μ=840,154 kWh the average AQ change for EUC 07-09 and standard deviation of 8,227,834 kWh.

The 95% worst-case scenario has been determined as a daily difference between estimate and actual as 39,452kWh per day.

The final settlement error has been determined as 0.2% of reads not being updated within the settlement window. This matches the total average from data in the East Midlands, provided by Xoserve.

4.5.3 Updating the Data

The risk needs to be updated with the mean yearly AQ change of products 1 and 2, percentage read failure by product 1 and 2 as well as the percentage check read not completed by product 1 and 2.

4.6 R6. Meter Read Submission Frequency for Product 4

This assesses the risk created by infrequent meter read submissions for sites in product 4. Where read frequency is lower there is a higher chance that the AQ will not reflect true consumption. The risk has been set up to consider all MPRNs in product 4.

4.6.1 Data Used

This risk uses similar data to risk three as shown below;

Average AQ	18,698	*Mod 81 Report- EUC 01-08*
Average AQ change between 13-14	-2.16%	*Mod 81 Report- EUC 01-08*
Standard Deviation	2.97%	*Spread of Change in AQ values between Shippers*
Average Decrease in AQ	- 538	
Standard Deviation	556	
1 in 20 Scenario - Change in consumption	377	*Derived using a normal distribution*
Average number of days between meter reads	136	*Data provided using Xoserve's sample data*
Energy error for VAR	117,695	*Daily kWh error*

4.6.2 Determining the 95% Worst-case Scenario

The 95% worst-case scenario is determined using a normal distribution that assesses the kWh difference between actual consumption and AQ for all MPRNs from in product 4.

4.6.3 Updating the Data

This risk should be updated periodically with the average days between meter readings and average AQ.

4.7 R7. Insufficient Maintenance of the Supply Point Register

The model assesses the risk created due to the inaccurate data in the supply point register. Some errors will cause settlement to process a significant consumption error that validation will not ordinarily block. We have used three scenarios to quantify that risk. Where the correction factor is not be correct, where the read factor is not correct and where no assets are attached to confirmed sites. This risk affects products 1-4.

4.7.1 Data Used

We have used the data provided by Xoserve to track their data cleanse work in December 2014.

Potentially incorrect correction factors		Source: Xoserve's data cleanse reporting December 2014
Percentage of MPRNs potentially with an incorrect correction factor	0.0843%	From Xoserve data
Average AQ	18,698	Average AQ from Mod 81 report - kWh/Yea
1 in 20 worst case - Energy factor is out by a factor of 10	10.0	Factor Energy is incorrect by
Total energy error for VAR	854,791	Daily kWh error
Error split by product meter count		
P1	427	Daily kWh error
P2	855	Daily kWh error
P3	153,862	Daily kWh error
P4	699,646	Daily kWh error
Incorrect read factors		Source: Xoserve's data cleanse reporting December 2014
Percentage of MPRNs potentially with an incorrect read factor	0.0076%	From Xoserve data
Average AQ	18,698	Average AQ from Mod 81 report - kWh/Yea
1 in 20 worst case - Energy factor is out by a factor of 10	35.3	Factor Energy is incorrect by
Total energy error for VAR	293,439	Daily kWh error
Error split by product meter count		
P1	147	Daily kWh error
P2	293	Daily kWh error
P3	52,819	Daily kWh error
P4	240,180	Daily kWh error
No Assets attached to confirmed sites		Source: Xoserve's data cleanse reporting December 2014
Percentage of MPRNs potentially with an incorrect read factor	0.1383%	From Xoserve data
Average AQ	18,698	Average AQ from Mod 81 report - kWh/Yea
1 in 20 worst case - AQ accuracy	80%	Estimated correctness of the AQ ***(20% error)***
Total energy error for VAR	31,180	Daily kWh error
Error split by product meter count		
P1	16	Daily kWh error
P2	31	Daily kWh error
P3	5,612	Daily kWh error
P4	25,521	Daily kWh error

4.7.2 Determining the 95% Worst-case Scenario

To demonstrate the 95% worst-case scenario we have used the following scenarios;

- Correction factors being incorrect by a factor of 10
- Read factors being incorrect by a factor of 35.3
- The AQ of sites with unconfirmed assets being 20% incorrect.

4.7.3 Updating the Data

On request, Xoserve may be able to provide information around the percentage of MPRNs which have potentially incorrect correction factors, incorrect read factors and unconfirmed

assets. Xoserve currently complete reporting to maintain data quality we anticipate that this will continue; however, there is nothing in UNC code to mandate shippers to maintain problem sites as they are identified.

4.8 R8. Change of Shipper

The model assesses the risk created by estimated reads at change of supply on product 4 only. Where the shipper fails to provide any reading during a change of shipper, the transporter will provide an estimate 16 days following the transfer date. Change of shipper reads can be replaced with a shipper agreed within 12 months of the change of supply date. Where a change of shipper is completed using an estimate transfer read, and not replaced with an actual read, the closed reconciliation period of the previous shipper will end on an estimate and the new reconciliation period will begin on the same estimate. An estimated meter reading is used when:

- No actual reading was obtained;
- No actual is available because the actual transfer read was rejected due to data discrepancies; and
- Because a reading failed validation tolerances, due to an incorrect AQ.

We have assessed the risk of estimated transfer reads on accurate reconciliation. This risk affects product 4 sites as the length of time between reads provides a higher probability that the estimate will be inaccurate. Where the transfer read does not reflect reality the final allocation of energy to each shipper may be incorrect. Any misallocation in energy affects the two shippers who have been responsible for the meter point.

4.8.1 Data Used

Xoserve has provided data for the number of supply point confirmations by month and the percentage of estimated transfer reads used. The percentage of MPRNs that change shipper is deduced using the data provided by Xoserve and the total number of MPRNs on the Mod 81. Xoserve can provide an updated ad hoc report detailing the change of supply percentage, percentage of estimated reads used and the total number of supply points.

To determine the average difference in AQ we have used the average reduction from the latest Mod 81 report 10. The average number of days between meter reads for product 4 have been taken from an extract of showing all of the meter readings in the East Midlands.

MPRN Sample Size	21,714,664	*Mod 81 Report- Total MPRNs*
Number of supply point confirmations per year	2,782,040	*Report from Xoserve 3rd December 2014 CoS activity gas yr 13/14*
Approximate CoS per day within the LDZ modelled	772	*Using the model LDZ size*
Probability of Estimated Reading Used and not replaced	0.343	*Report from Xoserve December 2014 showing, supply point confirmations, estimated reads and SARs.*
1 in 20 number of estimated CoS reads per day	287	
Average AQ	18,698	*Mod 81 Report- EUC 01-09*
Average AQ change between 13-14	-2.16%	*Mod 81 Report- EUC 01-09*
Average Difference in AQ compared to consumption	404	
Average time between meter reads in product 4	136	*Report from Xoserve 3rd December 2014*

4.8.2 Determining the 95% Worst-case Scenario

A binomial distribution has been used with parameters n = number of change of shipper events and p = probability the transfer read remains as an estimate.

4.8.3 Updating the Data

Xoserve can provide ad hoc reports on the following;

- Number of supply point confirmations per month;
- Percentage of estimated transfer reads;
- Number of SARs that have been accepted;
- Latest meter read date which can be used to determine meter read frequency; and
- Yearly AQ change.

4.9 R9. Late or Incomplete Check Reads

Nexus rules transfer the check read obligation from transporters to shippers where equipment is in place that derives meter readings. If shippers do not fulfil their obligation there is a risk that metering drift will not be correctly assigned to the right shippers. It may be that all AMR devices derive reads, which has been used as the base case for assessing this risk.

Shippers are required to complete check reads for all metering equipment that derives a read within the 12 months for MPRNs in products 1-3 and monthly read sites in product 4 and every 24 months for annually read sites within product 4. This affects product 1-4 which could be all AMR devices. The risk of not completing these check reads is that drift is not identified.

4.9.1 Data Used

We have used data from Mod 81 report 10 to determine the average AQ for EUC 03-09; however, we have reduced the estimate to 250,000 to account for I&C sites that are in EUC 01 and 02. The PAW should update this data if a better estimate becomes available. The percentage of sites requiring a check read is determined as the total percentage of I&C MPRNs within the market.

We have estimated the number of sites requiring a check reads and the impact of not completing these check reads. We have also estimated the energy consumed by meters in each products.

Percentage of sites requiring a check read	3%	*Estimate based on the total number of AMRs*
Average AQ for I&C sites	250,000	*Engage estimate (Mod 81 Report 10 EUC 03-09 AQ-906,2*
Average difference between check read and actual	2%	*Engage Estimate*
1 in 20 event - percentage of late check reads	15%	*Engage Estimate*
1 in 20 event - percentage of uncompleted check reads within the settlement window	0.02%	*Engage Estimate*
Energy error for initial allocation	135,317	*Daily kWh error*
Energy error for final allocation	180	*Daily kWh error*
Percentage of Product 3 which is I&C energy volume	75%	*Engage Estimate - To be Updated by the PAW*
Percentage of Product 4 which is I&C energy volume	5%	*Engage Estimate - To be Updated by the PAW*
I&C Energy by Product		*Proportion of all energy that is I&C in product*
P1	1.00%	
P2	5.00%	
P3	11.25%	
P4	3.95%	
Total	21%	
I&C Energy Split		*Split of I&C between products*
P1	5%	
P2	24%	
P3	53%	
P4	19%	
Total	100%	
Initial Energy error for VAR P1	6,383	*Daily kWh error*
Initial Energy error for VAR P2	31,914	*Daily kWh error*
Initial Energy error for VAR P3	71,807	*Daily kWh error*
Initial Energy error for VAR P4	25,212	*Daily kWh error*
Final Energy error for VAR P1	9	*Daily kWh error*
Final Energy error for VAR P2	43	*Daily kWh error*
Final Energy error for VAR P3	96	*Daily kWh error*
Final Energy error for VAR P4	34	*Daily kWh error*

4.9.2 Determining the 95% Worst-case Scenario

The 95% worst case has been estimated as 5% of qualifying sites have not had a check read. Currently there is no data available to enable this estimate to be updated.

4.9.3 Updating the Data

The average AQ of I&C sites and the percentage of check reads completed would need to be updated. A report from Xoserve could be used to determine a more accurate AQ for meters that derive reads.

4.10 R10. Shipperless Sites

The model evaluates the performance risk created because of shippers erroneously withdrawing from sites that continue to consume gas. All energy consumed by shipperless sites is allocated to unidentified energy. This risk affects product 1-4.

4.10.1 Data Used

Xoserve has provided a report on the number of isolations per year. The probability of a site which has been withdrawn from still consuming gas has been determined as 0.05 (5%).

The average AQ has been determined using the Mod 81 report. Engage has determined the detection rate 1 year per site.

Number of Isolations per year	73,473	*Xosere Report November 2014*
Probability still consuming gas	0.05	*Engage Estimate*
Isolations per day	201	*Xosere Report November 2014*
Average AQ	18,698	*From Mod 81 Report 10- Risk 03 Data*
Length of time remains undetected years	0.75	*Average time until GSR visit*
1 in 20 worst case no of shipperless sites created per day	15	*Taking a binomial distribution*

4.10.2 Determining the 95% Worst-case Scenario

A binomial distribution has been used with parameters n = number of isolations per day and p=probability an isolation has been completed but the site continues to consume gas.

4.10.3 Updating the Data

The PAW can update;

- The number of isolations per year;
- The probability of a site continuing to consume gas; and
- The detection rate of the shipperless sites, which have been created.

The model can be run using different parameters as the effects of UNC Modification 424, 425 are more widely understood, and further data becomes available.

4.11 R11. Theft of Gas

Theft of gas creates a risk to shipper allocation as unidentified gas is inflated. The model evaluates the value at risk created misallocation of gas volume to the market. The AUGE report evaluates the suspected amount of theft. We have used a range from the latest AUGE statement to evaluate the worst-case scenario. This risk affects products 1-4.

4.11.1 Data Used

The latest AUGE statement provides a range of percentages, which we have used to evaluate risk.

Minimum estimated amount of theft	0.0060%	*AUGE Statement Page 13*
Maximum estimated amount of theft (1 in 20)	10%	*AUGE Statement Page 13*

4.11.2 Determining the 95% Worst-case Scenario

The 1 in 20 worst-case scenario has been determined using information from page 13 of the AUGE statement which identifies that theft may be as much as 10% of throughput.

4.11.3 Updating the Data

There will no longer be an AUGE statement following Nexus go-live. There may be data that can be used from the theft of gas risk assessment service that can be used to update this risk.

4.12 R12. Fair Use of the AQ Correction Process

When an AQ or SOQ prevents Xoserve from accepting a correct meter reading then the shipper can submit an AQ correction. Following the correction an updated AQ or SOQ would allow Xoserve to accept future meter reads and use them for individual meter point reconciliation.

We have assessed the risk of shippers using the AQ correction process in a biased way i.e. only correcting certain AQ changes. AQ corrections are likely to be required on increasing AQs as zero consumption is permitted within the Nexus rules. AQ corrections will only affect MPRNs in product 4.

4.12.1 Data Used

An AQ correction will be required if the AQ is increasing by 3 times the current size, for EUC 01. We have used three times the average AQ for the worst case. Xoserve has provided a report of the latest meter readings for all MPRNs in the East Midlands and we have used this to determine that the average time between meter readings is 136 days. The number of meter reads which will fail tolerances as a result of AQ/SOQ being incorrect was provided by Xoserve to the Project Nexus workgroup on 24th November 2014.

Average AQ	18,698	*2014 Mod 81 report*
300% average AQ	56,095	*Maximum acceptible tolerance for EUC01 according to the BRDs*
1 in 20 worst case	56,095	*Maximum acceptible tolerance for EUC01 according to the BRDs*
Average days between meter reads in product 4	136	
Number of Reads submitted annually	4,664,485	*Derived using days between meter reads and MPRNs in product 4*
Number of Meter Read Failure	1.6%	
Number of AQ corrections daily	204	*Approximated by number of daily failed reads*
1 in 20 change in consumption	13,934	
Energy error for VAR	2,849,094	*Daily kWh error*

4.12.2 Determining the 95% Worst-case Scenario

The likely AQ following an AQ correction is 3 times the size of the current AQ – this is because of the level of change needed to fix validation where the tolerances are of this size. The model uses this to determine the 1 in 20 worst-case scenario.

The maximum number of AQ corrections has been determined as the number of meter read failures that cannot be corrected and resubmitted.

4.12.3 Updating the Data

Xoserve may be able to provide updated information on actual meter read rejection percentages and average AQ following project Nexus go-live. Xoserve may also be able to provide updated information on meter read frequency on an ad hoc basis, but this should be discussed between Xoserve and the PAW.

4.13 R13. Lack of Winter Annual Ratio Band calculation for Sites in Product 4

The model assesses the risk of not completing a site-specific winter consumption profile on sites in product 4. Currently a Winter Annual Ratio (WAR) is used to determine a site-specific winter consumption for a monthly read site with an AQ > 293,000kWh. It is calculated as the December to March consumption divided by the AQ. If the meter readings are not available to complete a site specific WAR the default EUC profile is used. Following Nexus go-live product 3 sites will be reconciled monthly so the effect will be minimal. The main effect will be a profiling effect to initial allocation of all sites within product 4.

4.13.1 Data Used

The Mod 81 report 10 has been used to determine the percentage of sites that should have a site specific WAR band. The average AQ of these MPRNs is also determined from the Mod 81 report.

Total MPRNs on Mod 81 Report	21,714,664	*Data from Report 10 Mod 81*
Number of MPRNs elligible for a site specific WAR	123,945	*Provided by Fiona Cottam 31st December 2014*
Percentage elligible for a site specific WAR	0.57%	
Average AQ for EUC 03 and above	906,249	*Data from Report 10 - Mod 81 report*
1 in 20 worst case difference in AQ during the winter	10.0%	*AQ is incorrect- Estimated by Engage*
Percentage site specific WAR completed	75.0%	

4.13.2 Determining the 95% Worst-case Scenario

By comparing load factors of the four different profiles Engage have estimated that the worst case scenario would be the winter profile is incorrect by 10%.

4.13.3 Updating the Data

Currently there is no way of updating this data without an ad hoc report request to Xoserve.

4.14 R14. Bias approach to retrospective updates

Following Nexus go-live shippers will be able to update historic data items more readily.

The model assesses the risk of shippers not completing retrospective updates in a fair and even way. Where retrospective updates have an impact on consumption a reconciliation or a re-reconciliation will be completed. It would be possible for a shipper to use the retrospective updates process only where they are advantaged financially. This is a risk to product 3 and 4 allocation.

4.14.1 Data Used

We have used the number of RFA and CDQ query in Conquest as an approximation for the number of adjustments.

The average AQ has been taken from the Mod 81 report. Engage have estimated the percentage impact on reconciled energy.

Number of MPRNs in LDZ	2,200,000	*Core data*
Forecast percentage of MPRNs which require retrospective update affecting reconcilation	0.04%	*Percentage of Request for Adjustment & Consumption Dispute Queries in 2012*
Average impact on reconcilation	1.00%	*Engage estimate*
Average AQ	18,698	*Mod 81 Report 10*
Average impact on reconcilation	187	
1 in 20 impact on reconciliation	210	

4.14.2 Determining the 95% Worst-case Scenario

Engage have estimated a 1 % difference on energy allocation.

4.14.3 Updating the Data

Xoserve may be able to provide the number of retrospective updates that are process when Nexus has be implemented.

4.15 R15. Unregistered Sites

The model evaluates the performance risk created because of unregistered sites that have never been on the supply point register. All energy consumed by these sites are allocated to unidentified energy. This risk affects products 1-4.

4.15.1 Data Used

Xoserve have provided a report on the number of MPRN creations per year. The probability of a site which has been withdrawn from still consuming gas has been determined as 0.05 (5%).

The average AQ has been determined using the Mod 81 report.

Average Number of New MPRNs created per day	145	*Data provided by Xoserve*
Probability that these will become unregistered	5.0%	*Engage estimate to be updated with data from Xoserve*
1 in 20 worst case scenario for the number unregistered sites	12	*Using a binomial ditsibution with n= number of MPRNs created per day and p=probability they will become unregistered.*
Average AQ	18,698	*Mod 81 report 10*
Detection Rate	50.0%	
Length of time remains undetected years	2	

4.15.2 Determining the 95% Worst-case Scenario

A binomial distribution has been used with parameters n = number of MPRNs created per day and p=probability is the probability of these MPRNs being created and not consuming gas. This can be updated as more information becomes available.

4.15.3 Updating the Data

The PAW can update the following parameters;

- The number of MPRN creations per year;
- The probability of a site not being registered and consuming gas; and
- The detection rate of the unregistered sites.

5 Updating Reference Data and Running Scenarios

This data should be updated by the PAW to assess the value at risk in different market conditions. The uptake of different settlement product categories is likely to change as shippers develop their own strategies to optimise the new functionality created through Project Nexus.

5.1 Shipper Matrix

This contains static data that defines characteristics of the modelled market.

Unidentified Gas is allocated based on consumption for the last 12 months so the current day's market shares and previous year's market share of energy consumption are required. These shares must be broken down by product category for each shipper. The PAW can update the overall product split of the settlement market. The PAW can also update the product split by overall meters, as some risks such as change of supply is dependent on both energy consumption and number of meters.

The cells that are light brown in the shipper matrix tab should be agreed and updated manually by the PAW.

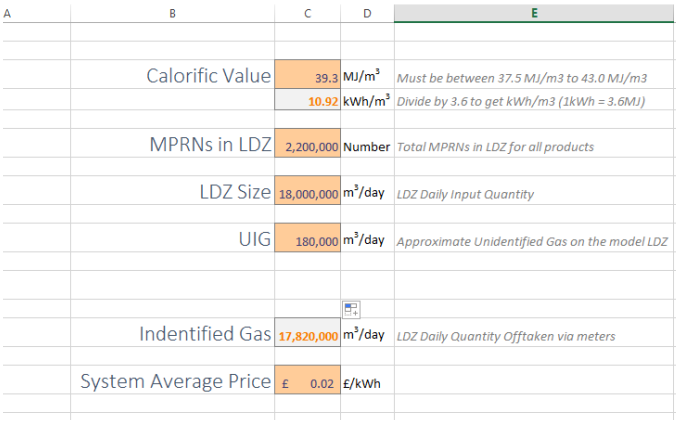
		Year before model (Y-1)				Model Day			
		Product 1	Product 2	Product 3	Product 4				
Shipper	Shipper Name	P1	P2	P3	P4	P1	P2	P3	P4
1	Small Polluter	0%	0%	2%	2%	0%	0%	3%	3%
2	Medium Polluter	10%	0%	20%	1%	10%	1%	19%	0%
3	Large Polluter	4%	10%	0%	13%	4%	10%	5%	14%
4	Small Polluted	0%	0%	4%	4%	0%	0%	5%	5%
5	Medium Polluted	10%	10%	10%	1%	10%	12%	10%	2%
6	Large Polluted	4%	12%	25%	15%	4%	12%	28%	12%
7	Residual Polluted	72%	68%	39%	64%	72%	65%	30%	64%
						These are used for initial allocation			
	Checks	OK	OK	OK	OK	OK	OK	OK	OK

	Year before model (Y-1)				Model Day			
	P1	P2	P3	P4	P1	P2	P3	P4
Product Split (Energy)	1%	5%	15%	79%	1%	5%	15%	79%
					P1	P2	P3	P4
Product Split (Meters)					0.05%	0.10%	18.00%	81.85%
					1,100	2,200	396,000	1,800,700

Shipper 1-3 are coloured red to represent polluting shippers. These shippers realise the risks and their allocation and reconciliation will have corresponding errors simulated. The risks pollute the other shippers and their allocation and reconciliation where appropriate. Shippers 4-6 are polluted, and will not negatively affect settlement allocation. Shipper 7 is the residual market.

5.2 Common Data

This common data determines the key characteristic of the LDZ. The model looks at one settlement day and extrapolates this risk to a year. Calorific value is the average forecast obtained from Distribution Network Operators shrinkage statements. MPRNs is an approximate size of an average LDZ. The LDZ size is the total gas usage in m^3 for 23rd November divided by 13. The Unidentified Gas is 1% of throughput as approximated by the AUGE. The system average price is the average price for gas year 2013/2014. Data can be used to refresh the AUGE percentage following publication of their yearly statement. Average CVs are published in the DN shrinkage statements. National Grid's data Item Explorer Website can be used to determine the most appropriate system price to be used in the settlement calculations.



Calorific Value	39.3	MJ/m³	*Must be between 37.5 MJ/m3 to 43.0 MJ/m3*
	10.92	kWh/m³	*Divide by 3.6 to get kWh/m3 (1kWh = 3.6MJ)*
MPRNs in LDZ	2,200,000	Number	*Total MPRNs in LDZ for all products*
LDZ Size	18,000,000	m³/day	*LDZ Daily Input Quantity*
UIG	180,000	m³/day	*Approximate Unidentified Gas on the model LDZ*
Indentified Gas	17,820,000	m³/day	*LDZ Daily Quantity Offtaken via meters*
System Average Price	£ 0.02	£/kWh	

5.3 Updating Risk Parameters

The PAW should adjust the parameter control tab if it is felt that a risk has moved from one product category to another or from allocation to reconciliation. This can be done by un-hiding the parameter control section between column A and E within each risk tab. The parameter can then be changed from false to true or vice versa for each product. It can also be updated to move the risk from allocation to reconciliation or vice versa.

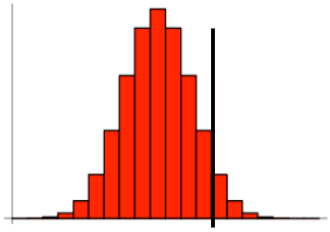
Appendix A Probability Distributions

We have used two cumulative probability distributions to determine the 95% worst-case scenario. Binomial distributions have been used for discrete events, i.e. these distributions have been used for customers changing shipper, where only a whole number of change of shipper events can occur. Normal distributions have been used for continuous probability such as energy consumption.

A 1 Binomial Distribution

The binomial distribution is for x discrete events it has parameters n and p and is characterised as follows;

- n is the number of independent events, n must be a whole number.
- p is the probability of a success occurring where p must be between 0-1
- q is 1-p
- X is number of success that occurring from a total of n trials.



$$P(X) = \frac{n!}{(n-X)!\,X!} \cdot (p)^X \cdot (q)^{n-X}$$

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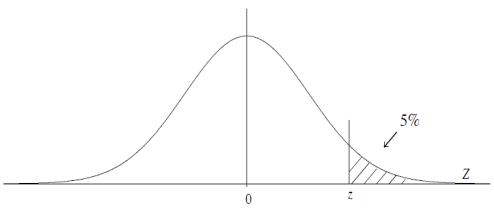
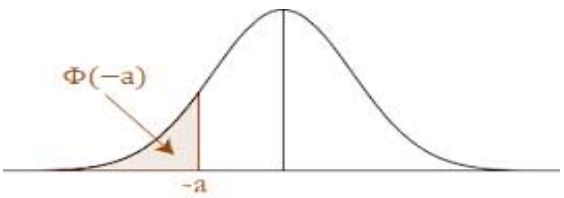
A 2 Normal Distribution

To be used for continuous probability distributions taking a symmetrical distribution. Normal distribution take parameters μ and σ^2 with the following characteristics;

- μ = mean and σ^2 = standard deviation of a set of data.
- In diagram A below z is the number of successes, this shows a 95% score of less than z.
- Diagram B shows how to find the 5% probability where there is a negative mean (where AQs are decreasing).

A



B